NASA Innovative Advanced Concepts

10 meter Sub-Orbital Large Balloon Reflector (LBR)

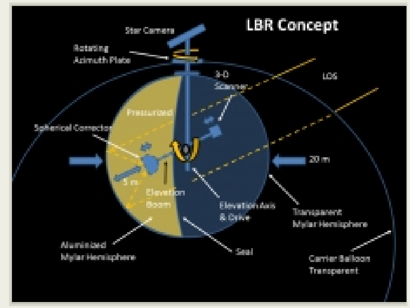
Completed Technology Project (2013 - 2014)

Project Introduction

This is the lead NIAC Phase II proposal for "10 meter Sub-Orbital Large Balloon Reflector (LBR)" with Christopher K. Walker as PI. We propose to develop and demonstrate the technology required to realize a suborbital, 10 meter class telescope suitable for operation from radio to THz frequencies. The telescope consists of an inflatable, half-aluminized spherical reflector deployed within a much larger carrier stratospheric balloon. Besides serving as a launch vehicle, the carrier balloon provides a stable mount for the enclosed telescope. Looking up, the LBR will serve as a telescope. Looking down, the LBR can be used for remote sensing or telecommunication activities. By combining successful suborbital balloon and ground-based telescope technologies, the dream of a 10 meter class telescope free of ~99% of the Earth's atmospheric absorption in the far-infrared can be realized. The same telescope can also be used to perform sensitive, high spectral and spatial resolution limb sounding studies of the Earth's atmosphere in greenhouse gases and serve as a high flying hub for any number of telecommunications and surveillance activities. LBR is a multi-institution effort between the University of Arizona (the PI institution), SWRI, JPL, and APL. LBR was selected in 2013 by the NASA Innovative Advanced Concepts (NIAC) program to proceed into Step B of the NIAC Phase I program. This makes LBR eligible to propose for a 2014 Phase II award. The goal of our NIAC Phase II effort is to bring LBR concepts to a Technology Readiness Level of at least 2 in maturity, by addressing key unknowns, assumptions, risks, and paths forward remaining after the completion of our Phase I study.

Anticipated Benefits

The realization of a large, space-based 10 meter class telescope for far-infrared/THz studies has long been a goal of NASA. Such a telescope could study the origins of stars, planets, molecular clouds, and galaxies; providing a much needed means of following-up on tantalizing results from recent successful missions such as Spitzer, Herschel, and SOFIA. By combining successful suborbital balloon and ground-based telescope technologies, the dream of a 10 meter class telescope free of ~99% of the Earth's atmospheric absorption in the far-infrared can be realized. The same telescope can also be used to perform sensitive, high spectral and spatial resolution limb sounding studies of the Earth's atmosphere in greenhouse gases such as CO, ClO, O3, and water, as well as serve as a high flying hub for any number of telecommunications and surveillance activities. Flight times of 100+ days will be possible, with instruments having mass and power requirements in excess of ~500 kg and ~1 kW.



Early Concept Diagram

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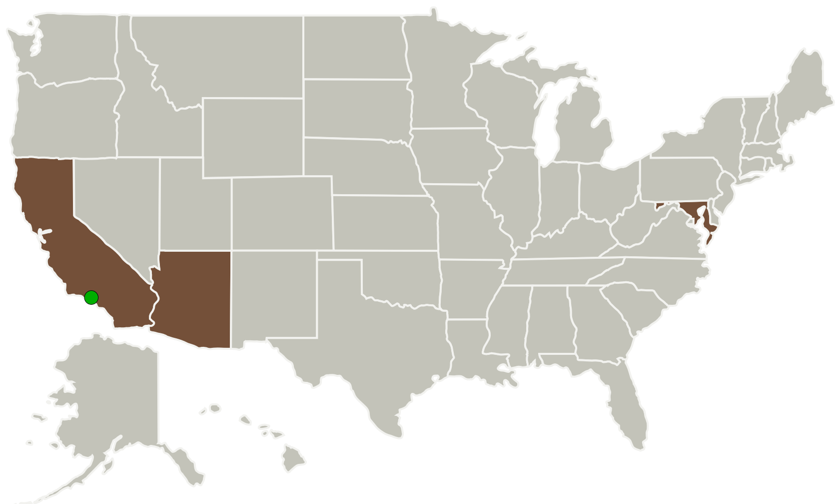
10 meter Sub-Orbital Large Balloon Reflector (LBR)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Arizona	Lead Organization	Academia	Tucson, Arizona
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
Johns Hopkins University	Supporting Organization	Academia	Baltimore, Maryland
Southwest Research Institute - San Antonio(SWRI)	Supporting Organization	Academia	San Antonio, Texas

Primary U.S. Work Locations	
Arizona	California
Maryland	

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Arizona

Responsible Program:

NASA Innovative Advanced Concepts

Project Management

Program Director:

Jason E Derleth

Program Manager:

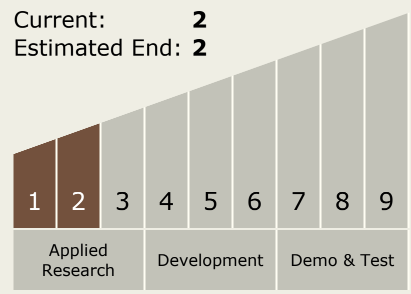
Eric A Eberly

Principal Investigator:

Christopher M Walker

Technology Maturity (TRL)

Start: **1**
Current: **2**
Estimated End: **2**



Project Transitions

July 2013: Project Start

March 2014: Closed out

Closeout Summary: The realization of a large, space-based 10 meter class tele scope for far-infrared/THz studies has long been a goal of NASA. Such a telesco pe could study the origins of stars, planets, molecular clouds, and galaxies; prov iding a much needed means of following-up on tantalizing results from recent su ccessful missions such as Spitzer, Herschel, and SOFIA. Indeed, Herschel began its life in the US space program as the Large Deployable Reflector (LDR) - to be assembled in low Earth orbit by shuttle astronauts. Escalating costs and smaller federal budget allocations resulted in a downsizing of the mission. However, by combining successful suborbital balloon and ground-based telescope technologie s, the dream of a 10 meter class telescope free of ~99% of the Earth's atmosph eric absorption in the far-infrared can be realized. The same telescope can also be used to perform sensitive, high spectral and spatial resolution limb sounding studies of the Earth's atmosphere in greenhouse gases such as CO, ClO, O3, an d water, as well as serve as a high flying hub for any number of telecommunicat ions and surveillance activities. Flight times of 100+ days will be possible, with i nstruments having mass and power requirements in excess of ~500 kg and ~1 kW. Here we present the results of our NIAC Step 1, Phase B design study wher e each key aspect of the LBR concept is discussed and recommendations made f or further study in Phase II. These aspects include realization of a large spherica l reflecting surface, spherical corrector, pointing system, instrument module, an d service module/gondola. Once each hardware component is introduced, a typi cal LBR Mission profile is described that enables the realization of a stratospheric 10 meter THz observatory and limb sounder. Verification of the design approach was achieved by using a combination of analytical modelling, lab testing of mate rials and techniques, and building a 3 meter rooftop LBR prototype. LBR directly addresses NASA's Strategic Goals 2, 3, 5, and 6.

Technology Areas

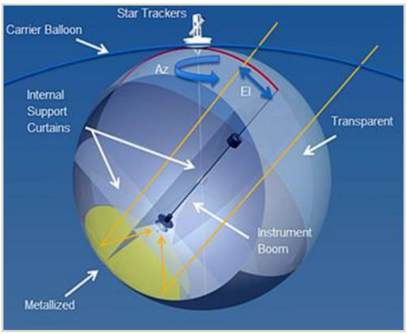
Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - └ TX05.2 Radio Frequency
    - └ TX05.2.6 Innovative Antennas

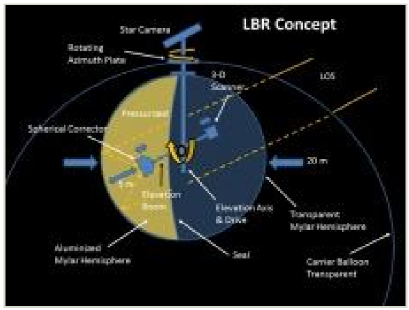
Target Destination

Earth

Images



Large Balloon Reflector Concept
Concept diagram
(https://techport.nasa.gov/image/102184)



Large Balloon Reflector Early Concept
Early Concept Diagram
(https://techport.nasa.gov/image/102193)

Project Website:

http://soral.as.arizona.edu/LBR/